529. b. 10

ENNEADES ARITHMETICÆ;

THE

NUMBRING NINES.

OR,

PYTHAGORAS His TABLE

Extended to

All Whole Numbers under 10000.

AND

The Numbring RODS

Of the Right Honourable

JOHN LORD NEPEER,

Enlarged

With 9999 Fixt Columns or Rods, of Single, Double, Triple and Quadruple Figures, and With a New Sort of Double and Moveable Rods, for the much more sure, plain and Easie performance of *Multiplication*, *Division*, and *Extraction of Roots*.

The Whole being very Useful for most Persons, of whatsoever Calling and Employment, in all Arts and Sciences.

All having frequent Occasions of *Accompts*, *Numbring*, *Measuring*, *Surveying*, *Gauging*, *Weighing*, *Demonstrating*, &c. The Devine Wisdom having from the Beginning

Disposed all things in Measure, Number and Weight, Sap. 11.21.

LONDON.

Printed for *Joseph Moxon*, at the Sign of *Atlas* in *Ludgate-street*. Where also these Numbring Rods, (commonly Call'd *Napiers Bones*) are made and Sold. 1684.

10

To the READER.

Courteous Reader,

THE *End and Use of the Ensuing Table will be the better understood, if something in Brief, by way of Preface, be premised concerning these Three Points. First, the* Table of Pythagoras; *Secondly,* the Extensions of the same; *and Thirdly,* the Numbring Rods. *Wherefore be pleased to peruse the following Preamble concerning the said Points; The Reading whereof will not Cost thee much above an Hour or Two. But First, vouchsafe to hear, what is meant by the New Title of* Enneades Arithmeticæ, or Numbring Nines.

The whole following Table containing Gradually all the whole Numbers from 1. *to* 9999. *Inclusive, Viz.* 9. *of One single Figure,* 90 *of Two Figures;* 900 *of Three Figures; And* 9000 *of four Figures: Again, every one of the said whole Numbers (multiplied severally by all the* 9 *Unites,* 1, 2, 3, 4, 5, 6, 7, 8, 9.) *making so many* Columns, *as there are Capital Numbers, to wit,* 9999. *each Column, con-*

sisting of 9 distinct Numbers, and these 9 Numbers being the products of 9 distinct Units, I think we may with good Reason call the said Columns (yea and the Numbring Rods also; For in effect they are the same thing) by the Name of Enneades Arithmeticæ, *that is, the numbring Nines, or more expressively, the numbring Ninities. For the Greek word* Ἐννεὰς *being a Nown Substantive, signifies properly the Number of nine in* abstracto, *which may as well be called a Ninitie, as* Ἑνὰς *signifying the Number of One in* abstracto, *is interpreted, Unity, and* τριὰς *signifying the Number of Three in* abstracto, *is Translated Trinity. But though there be but Nine Cells expresst in every Rod, yet one other Negative Cell of Cyphers is ever to be understood, which if you please, may be sufficiently insinuated by putting so many Points over the* Vertical Cell, *as there are Figures in the* Vertical; *see Figure* 10. *whose* Vertical

. . . .

is 1 2 3 4 *and may be pointed, as you see here, to insinuate a Supposed Cell of Cyphers.*

Concerning

Concerning the Table of PYTHAGORAS.

THE known Arithmetical Table, invented by *Pythagoras*, (such as you see expressed in Figure 1.) is not only an easie and sure Rule to *multiply* and *divide* by, but is also those very Operations themselves, *Multiplication and Division*, done to your Hands, and known by inspection, comprehending three distinct Numbers, proper to them both, *viz. Multiplicand*, *Multiplier* and *Product*, proper to Multiplication, *Dividend*, *Divisor* and *Quotient*, proper to Division. For if you take any one of the Numbers, seated in their several Cells between A and B. for a multiplicand; for example 8. and another Number of those that are seated in their several Cells between A and C for a *multiplier*, for example 7. in the Angle of their Concurse, you will find the Number 56. the just Product of 8 *multiplyed* by 7. Again, the said *Product* 56. is also a *Dividend*, whose *Divisor* is 8 in the highest Cell, above the *Dividend* and *Quotient* is 7 in the 7th. Lateral Cell, over against the *Dividend*, the better to distinguish the 9 Units, Figures, Numbers and Cells Seated between A and B. from the like Seated between A and C. call the first Capital Units, Figures, Numbers, Cells, &c. being

being placed in the Head of the Table: but the two Lying between A and C call *Lateral*, as occupying the side of the Table on the left Hand.

Every Capital number in the *Pythagorean* Table hath under it 8 other numbers lodged in 8 several quadrats or Cells, as you may see in Figure 1. all which 9 numbers make a kind of a little streight Column, parallel to the side A C or B D, The Columns are 9 answerable to the 9 *Units* or *Capital Numbers* in the Head of the Table. But observe also, that there are other 9 *Transverse Columns*, parallel to the side A B. or C D. which cross the former at Right Angles, and meet one another in a common Cell, ever containing a perfect *Quadrat Number*, whose Root appears in the Heads of the two Meeting Columns: For Example, the *Column* of 8 Capital meets with the *Transverse Col.* of 8 Lateral in the Cell of 64. a square Number. So 9 Capital Meets with 9 Lateral in the Cell of 81. a square Number, *&c.* But what is worthy of Observation, these two different sorts of Columns, *Capital and Transverse*, though most cross one to another, do most punctually agree in all their Numbers, without any difference, as is manifest to the Eye.

There are yet many things more, very Observable in the *Pythagorean* Table. The first is, that not only the 9 Units, are *multiplicand and Divisors* in it, but Tens, Hundreds, Thousands, 10000s, 100000. 1000000. 10000000 and 100000000. in great

great variety, and all actually and orderly Tabulated, shewing at the same time, their true Product and Dividends, with *multiplyers*, *Divisors*, and *Quotients*. As for *Tens* you see 12 Tabuated on the 1. and 2 *Col.* Then 23. 34. 45. 56 67. 78. 89. each number Tabulated on two Contiguous Columns. *As for Hundreds*, you see 123. Tabulated on the first 3 *Col.* Then 234 345. 456. *&c.* As *for Thousands*, you have 1234. Tabulated on the four first *Col.* Then 2345. 3456. 4567. *&c.* and so of the rest, till you come to 123456789. a *multiplicand* or *Divisor* of all the *Capital Units*, of the Table, whose *multiplyer* is one (or more, as you please) of the Lateral Units, and the *Product* is the Transverse Column of that *Unit*, which you choose for *multiplyer* to be counted from the Right Hand to the left. For example, if you *multiply* 123456789 by 2. the product will be the second transverse col. gathered from the right hand to the left, *viz.* 246913578. If you multiply it by 9. the product will be the 9th. transverse column, *viz.* 1111111101.

The second thing very observable is, that if you turn *Pythagoras* his Table in such manner, that all the Numbers remain unchang'd in their cells, and yet the Figures 9. 8. 7. 6. 5. 4 3. 2. 1. lying between C. and A. become *Vertical*, which before

before were *Lateral*, and 1. 2. 3. 4. 5. 6. 7. 8. 9. lying between A. and B. *become Lateral*, which before were *Vertical*, you may find another great Variety of *Multipliers*, *Divisors*, *Products*, *Dividends* and *Quotients*, and of greater Numbers than before, all differing from the former, and all Tabulated on contiguous columns. As for tens, you see 98 Tabulated on the two last transverse columns, then 87. 76. 65 *&c.* As for Hundreds, you have 987 876. 765. *&c.* And so for the rest, till you come to 987654321 a Multiplicand or Divisor made of all the Lateral unites from C. to A. which Number multiplied by 2. will have for product 1975308642. to be found in the *second Capital Column*, and gathered thence from the right Hand to the left. If you multiply it by 9. the *capital Column* of 9 will shew the product 8888838889.

The third observable thing is, That whatsoever under-cell of any Column, hath more figures or places in it, than are in the capital cell of that Column, then infallibly the Figure which is outmost on the left side of that under-cel; is to be added to the next Figure of another Column, if another Column be Tabulated by it on the left Hand. This Addition may be called *Collateral*, because it adds together two Figures on the sides of two Neigbouring Columns, and makes but one Number of them both. If the two Figures added

ded should make 10. then put down a cypher, and carry one to the next Number on the left Hand: If they make more then 10, put down the surplus and carry one. Take this example of *Collateral* Addition. If you Tabulate 12. with two Rods or Columns, *viz.* the column of 1 and the column of 2. in the 2d. Cell of both Rods together, is 24. in the 3d. Cell is 36. in the 4th. Cell is 48. but in the 5th. Cell is 510. which make not five Hundred and 10. but 60 only, because 1 and 5 (the Neighbouring Figures of 2 Columns) are to be added into one number 6, by reason that the 5th. Cell of the Column 2 hath 10. in it, a Figure more than in the Capital of the Column two. This Rule then is Universal, whatsoever under-cell of any column hath more Figures in it than are in the capital number of that column, there must be collateral Addition, if any other column be Tabulated on the Left Hand with it. Note that this Rule holds good, not only in columns of single Units, but of Tens, 100ds. 1000ds. &c.

The 4th. Observable thing is, and of cheif moment, that all and every column, *Ennead*, or Rod (Synomical words in the present matter) not only of *Pythag.* his Table, but of all following Tables to 9999 and much more, is singularly useful both in *Division* and *multiplication* though the Column be never so little (except the Column of 1 the first Unit, which in Rigour neither devides nor multiplys any Number) and the *Dividend* and *multiplyer*

never so great. For in Division it performes the work, or gives the *Quotient*, by meer Substraction of its own Numbers out of the *Dividend*: and in *multiplication* it gives the Product, by setting down in due order its own numbers, and afterwards adding them into one Sum. For example, take the Column 25 and divide by it 7 8 9 6 5 2 5 the Quotient will be 3 1 5 8 6 1. and the work ended will appear as underneath (a) where note that the Numbers 75. 25. 125. 200. 150. 25. all marked with this mark ' - are taken out of the cells of the column 25. to be substracted out of the *partial Dividends*: 75. is taken out of the third cell, and gives you 3. to be set in the *Quotient*; 25 is taken out of the 1 cell, and gives one for the *Quotient*, and so of the rest, the Number shewing its cell, and the cell the *Quotient*. A-

(a) 25) 7 8 9 6 5 2 5 (3 1 5 8 6 1,
- 75
39
- 25
146
- 125
215
- 200
152
- 150
25
- 25
00

gain,

ain, take the column 25. for a *Multiplicand*. and multiply it by 315861. the *product* will be

7896525, which before was the Dividend. The Operation ended, will appear, as underneath at (*b*), Where note, that the Numbers 25. 150. 200. 125. 25. and 75. are all taken out of the cells of the column 25. to be placed as you see, and added into one sum for product of Multiplication. Here also you may observe, that the self-same cells or Numbers are added together in *Multiplication*, which were substracted in *Division*, only their Order inverted: what was first substracted in *Division*, is last taken and added in *Multiplication*, which always happens when the *Divisor* and *Quotient* become *Multiplicand* and *Multiplier* and reproduce the *Dividend* as *Product* of *Multiplication*.

The fifth thing observeable is, That every *Innead* or column, be it never so little or great,

```
          25
      315861
(b)       25
        150——5
        200——2
        125——5
        25——6
        75——9
        7——8
```


that

that is, of one, or more, or many Figures in its *Capital Cell*) by multiplying its Capital Number with 45, will produce a sum equal to all the Figures, as they stand in that col. added into one sum. For example, take the col. of 6. and multiply 61. by 45. the product will be 2745. which is just the sum of all the column added together, as appears in the margent (c). By this means you may examine any col. whether it be right or wrong.

(c)

61	
122	
183	
244	
305	
366	
427	
488	
549	
2745	

Add unto the former or fifth Observation another, not much unlike, to be seen in this little Table of *Roots*, *squares* and *cubes*, or rather of the ending Figures or Units of all Roots, Squares and Cubes whatsoever; where you see the sum of each column by Addition, to be severally 45. The *first Column* is of the first ten Roots, from 0 to 9 inclusive, but all following Roots have the same ending Figures, and in the same order, as in the first column. *The second Column* is of the first ten ending Figures of Squares; the first ten Squares, and all the following Squares have the

R.	sq.	cub.
0	0	0
1	1	1
2	4	8
3	9	7
4	6	4
5	5	5
6	6	6
7	9	3
8	4	2
9	1	9
45	45	45

the ſame ending Figures, and in the ſame Order as in the ſecond column. *The third Column* is of the firſt ten ending Figures of the firſt ten Cubes, and all the following Cubes have the ſame ending Figures, and in the ſame order as in the third column. By the ending Figure of any Root, you may know the ending figure both of the ſquare and cube by this Table; in which the *ſquare* and *cube* ſtand right over againſt the *Roots*. Hence may you know, whether a Table of Roots, ſquares and cubes be well made or no: for if any ten ending *Roots*, or *Squares*, or *Cubes* lying next one under another do not make the ſum 45, or that the ſquares and cubes do not anſwer the roots, as in this Table, there muſt neceſſarily be an Errour committed.

The 6th. thing very remarkable, and indeed admirable is, that *multiplication and Diviſion* being two very diſtinct and different Operations, yet they ſo inſeparably and eſſentially accompany one another, that the one, for example, *Multiplication* can never be wrought or Finiſhed by its proper Rules, but that *Diviſion* at the ſame time ſhall be given you without working by any Rules of Diviſion: yea, when the Operator did neither intend Diviſion, nor ſo much as think of it. That they are two different Operations, it is clear. For

1. *Multiplication*, by two Numbers given (*multiplicand and multiplier*) ſeeks a third, *Viz.* the *Factum or Product*: But *Diviſion* by

two Numbers given, different from those of *Multiplication*, (*Divisor and Dividend*) seeks a third, *viz.* the *Quotient*, different from the product of multiplication.

2. *Multiplication* begins its work with the least figure, and Ends it with the greatest: but *Division* quite contrary, begins with the greatest and Ends with the least.

3. *Multiplication* requires *Addition* only, without *Substraction*: But *Division* requires *Substraction* only, without *Addition*. Notwithstanding these differences of the two Operations, it is impossible to work a *Multiplication* but a *Division* will be at the same instant given you, without working or dividing. So is it also impossible to work a *Division* but a *Multiplication* shall be given you without working or multiplying. And the reason is manifest, because the self same three Numbers which constitute the Essence of *Multiplication* constitute also the Essence of *Division*, though under different denominations. The three Numbers in Multiplication are called *Multiplicand*, *Multiplyer* and *Product*. In *Division*, *Divisor*, *Quotient* and *Dividend*. And observe, that by how much a *Multiplcand* exceeds or comes short of his *Multiplyer*, by so much the *Divisor* will exceed or come short of his *Quotient*. The *Product of Multiplication* is ever equal to the *Dividend in Division*. See the following example.

Multi-

Multiplication wrought		*Diviſion Given*	
Multiplicand	144	*Diviſor*	144
Multiplier	12	*Quotient*	12
Product	1728	*Dividend*	2728

Diviſion wrought		*Multiplication Given*	
Diviſor	7324	*Multiplicand*	7324
Dividend	4789896	*Product*	4789896
Quotient	654	*Multiplier*	654

Obſerve, that when in *Multiplication* the leſs Number is made the *Multiplicand*, and the greater the *Multiplier*; Then in *Diviſion* given, the *Diviſor* is the leſs Number, and the *Quotient* the greater. Example.

Multiplicand	12	*Diviſor*	12
Multiplier	144	*Quotient*	144
Product	1728	*Dividend*	1728

The 7th. thing obſervable is, That the third, fourth and fifth *Cell* of every *Ennead* (whether it hath one, or more or many Figures in its Verticall, and thoſe either pure integers or mixt with Fractions) contain three different Numbers, which are exact *Roots* of three *exact Square Numbers*, the two leſs being exactly equal to the greateſt, according to the 47. *Prop. l.* 1. *Euclides*, and the *Sides* or *Roots* making the perfecteſt ſort of right angle triangles, keeping proportion one to another, as 3, 4 and 5. and having conſtantly theſe

Angles

Angles *proxime* 90. 53. 8'. and 36. 52'. For example, take the Rod of 4. whose *third, fourth and fifth Cells* contain these three Numbers 12. 16. and 20. the sides of a right Angle triangle and true *Roots* of these three square Numbers 144. 256 and 400. Now the two less squares 144. and 256 added together, make exactly 400. *the greatest square of the greatest root*. Other right ang. Triang. that have not the said proportion of Sides, and aforesaid Angles, must necessarily have one or more defective Roots for their Sides, which will either come short or overshoot the truth, when we endeavor to square the unsquareable Numbers.

The eighth Point observable is, that though some Columns or Enneads refuse all *Collateral* Addition, (because they have no more Figures in the 8. under cells, than in the Vertical) yet others far more in Number require it. For in the whole following Table of Columns, from 1. to 9999. there are only 127. that refuse collat. addition whereas 9872 require it, in one or more of their under cells. In the single Columns of the 9 Units, only the first or column of 1. refuseth Collat. Add. In the double columns of Tens, only the two first, *viz.* column 10 and 11. In the triple columns of Hundreds, only the twelve first, that is, all from column 100 to 111 *inclusive*. In the Quadruple columns of Thousands, only the first 112 Columns, that is, all from column 1000

to

to Col. 1111 inclusive; All which 127 Columns or bones are void of all collat. add. And therefore all the 8 Under cells in them are marked with Stars, as Signes of non-addition. Note, that no Vertical cells have any collat. add. nor stars before them. Note also, that no *Ennead*, be it never so great, or have many Figures in the Vertical cell, can have any collat. add. in any one Under cell, if the two first Figures of the Vertical begin with 10 or with these three 110 or these four 1110. *&c.* Though all the following Figures be never so great, as 9999 in *infinitum*.

The ninth thing Observable is, that by how much any *Ennead* contains more Figures in its Vertical cell, by so much is it the better to multiply and divide by, since it takes away all *collat. add.* the chief trouble in gathering the products in multiplication, and finding readily the *Quotients* in *Division*. For example, if you turn all the Vertical Units of *Pytha.* Table into one Sum, *viz.* 123456789. and multiply it severally by 1. 2. 3. 4. *&c*, it wou'd make an *Ennead* such, as you see expresst in Figure 13. far different from Figure 1. the Table of *Pytha.* whose *collat. add.* it wholy takes away, and yet in substance is the same with the Table.

Concerning the Extensions of Pythagoras *his Table.*

The *Extensions* of the *Pytha.* Table may be distinguished into two sorts, the *greater*, and the less. The greater extends it two ways; length way by *Capital Numbers*, and breadth way with as

many *lateral Numbers*: The leſs extends it on
length way by *Capitals* and not by any more L
terals, than are in *Pythæ.* Table; which are the
Units. For example, the firſt greater Extenſio
adds to the 9 *Capital* Units of the Table 90 mo
Capitals: that is, all the whole Numbers of tw
places between 10 and 99 inclusive: And the lik
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terals. As all the cells with their inclofed Num
in *Pythæ.* T. are known to be 81. by multiplyi
the two greateſt Units, 9 Capital and 9 Lateral t
gether; ſo by multiplying 99 by 99 the two gre
eſt *Capital* and *Lateral Numbers* of two places, y
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to be 9801. The firſt leſs Extenſion adds to the
Capital Units (as did the firſt greater Extenſio
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ſive, but adds not any one Number to *Pythago*
his 9 lateral Units. The cells of this Extenſion
multiplying 99 its greateſt Capital by 9, the gre
eſt *Lateral*, are found to be 891 which is not t
10th. part of 9801 the cells of the firſt grea
Extenſion. A Table of this kind of extent, c
taining 9801 cells would be very uſeful, and be
of a Moderate largeneſs, occupying about 10
11 pages in *Folio*, might be eaſily made, as ſo
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he one of 5 *greater Extensions*, the other *of* 5 *less* Extensions, you may see their differences and how many cells, pages and Tomes in *Folio*, each one would contain. But first observe, that we allow a *Folium* to be 14 Inches long, and 8 broad, precinding from Margents, one page whereof will contain 112 square Inches, In every page reckon 1000 cells. In every Tome a 1000 pages.

Five greater Extensions of *Pythagoras* his Table:

Extensions	1st.	2d.	3d.
Multiplicand	99.	999.	9999.
Multiplier	99	999	9999.
Cells.	9801.	998001.	99980001.
Pages.	$10\frac{801}{900}$	$1108\frac{801}{900}$	$111088\frac{801}{900}$
Tomes.	0.	$1\frac{109}{1000}$	$111\frac{089}{1000}$

Extensions.	4th.	5th.
Multiplicand	99999.	999999.
Multiplier.	99999.	999999
Cells.	9999800001	999998000001
Pages.	$11110888\frac{801}{900}$	$111110888\frac{801}{900}$
Tomes.	$11110.\frac{889}{1000}$	$111110\frac{889}{1000}$

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Extensions	1st.	2d.	3d.
Multiplicand	99.	999.	9999.
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Cells.	9801.	998001.	99980001.
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Tomes.	0.	$1\frac{109}{1000}$	$111\frac{089}{1000}$

Extensions.	4th.	5th.
Multiplicand	99999.	999999.
Multiplier.	99999.	999999
Cells.	9999800001	999998000001
Pages.	$11110888\frac{801}{900}$	$111110888\frac{801}{900}$
Tomes.	$11110.\frac{889}{1000}$	$111110\frac{8889}{1000}$

Five leſs Extenſions.

Extenſions	1ſt.	2d.	3d.	4th.	5th.
Multiplicand	99	999	9999.	99999	999999
Multiplier	9	9.	9.	9.	9
Cells	891	8991.	89991	899999	8999991
Pages	0^{891}_{900}	9^{891}_{900}	99^{891}_{900}	999^{891}_{900}	9999^{891}_{900}
Tomes	0.	0	0	1-	10-

In theſe Tables, every Extenſion is expreſt by 5. oblong Quadrats, one under another. In the firſt Quadrat is the Number of the Extenſion, Firſt, ſecond or third, &c. In the ſecond Quadrat are two Numbers, a *Multiplicand*, and *Multiplier*, being the greateſt *capital Numbers*; and the greateſt *lateral Number* of that preſent Extenſion. In the third Quadrat is the *Product* of the aboveſaid *multiplicand* and *multiplier*, or Number of cells of the Extenſion. In the fourth *Quadrat* is the Number of pages in folio, which that Extenſion would make. Divide the cells by 900 and the *Quotient* will give the pages. In the fifth Quadrat is the Number of Tomes which that Extenſion would make. *Divide the Pages* by 1000. and the *Quotients* will give the Tomes. The Extenſions both of the greater and leſſer ſorts may be made *in infinitum*, though theſe two Tables exhibit only five of either ſort. It is incredible to our firſt apprehenſions, what a vaſt ſpace

ſpace would be taken up by a Table of the fifth

greater Extenſion, wherein, as you ſee, 999999.
apital Numbers are ſuppoſed to be multiplied by
ſo many Laterals, and to produce the Number of

cells 999998000001: and conſequently, accord-
ing to Allowances above-mentioned, pages

$1111108888\frac{301}{900}$, and Tomes in folio $1111108\frac{8}{9}$,
each Tome having 1000 pages, and (with its
cover) 3 inches in thickneſs. Theſe *Tomes*, if
they were ſet on end, contiguous one to another
in a ſtreight line, they would make a rank of
books above 52 Engliſh miles long. Or if all
the aforeſaid pages, their Margents cut off, ſhould
be laid cloſe one to another on a plain, they
would cover more than 30 ſquare Engliſh miles,
or 19200 ſquare Acres.

But ſetting aſide all Extenſions of the greater
ſort, we will content our ſelves with the third leſs
Extenſion, in which as the Table ſhews, 9999. is
the *greateſt capital Number* (*Multiplicand and Di-
viſor*) and 9. the greateſt lateral Number (*Mul-
tiplier and Quotient*. The product of cells is

89991. The pages in folio are $99\frac{991}{900}$ which
ſcarce make the 10th. part of a Tome in folio.
And obſerve that 9999 contains all the capitals,
both of the *Pythagorean Table*, and of the firſt,

ſecond and third leſs Extenſions. For 9 (the Unit on the right hand) counts the 9 Units of the Pythagorean Table; the next 9 counts 90 Numbers of two places, from 10 to 99 excluſive, and makes the firſt Extenſion. The third 9. counts 900 num. of 3 places, from 100 to 999. and makes the 2d. Extenſion: The 4th. 9 counts 9000 num. of 4 places, from 1000 to 9999. and makes the 3d. Extenſion obſerve alſo, that the foreſaid numbers, of 900. 900. and 9000. added together make juſt the number of 9999: and being multiplied ſeverally by 9 do produce ſeverally theſe num. 81. 810. 8100. 81000. all which added together, make up the juſt num. of cells of the 3d. leſs Extenſion *viz.* 8999. Obſerve laſtly, what we touched before ſpeaking of Pytha. Table, that every Capital number from 1 to 9999 being multiplied by all the 9 Units or ſingle figures, produces 9 diſtinct numbers, one greater than another, which being orderly placed and perpendicularly one under another, make a certain column, whoſe length is divided into 9 equal parts or cells, the Seats of the 9 Numbers produced, the Capital being the higheſt. Wherfore there being 9999 Capitals in this preſent Table, there muſt be alſo 9999 Columns, which in ſubſtance and in effect are the *Numbring Nines*, *Enneads*, *Rods* or *Bones*, or what elſe you pleaſe to call them: and not only the ſingle Rods of Units (as they were firſt invented, and hitherto too commonly uſed) but

double

double Rods of Tens, Triple Rods of Hundreds, and quadruple Rods of Thousands: So that whatever Operation can be performed in matter of Multiplication or Division, by 1. 2. 3. or 4. of the single Rods, the same may be performed by one Rod or column of this Table, and with far greater expedition, without any collateral Addition. For here are actually Tabulated to your Hand all and every whole Number (*Multiplicands and Divisors*) under 10000, and ever with one column or Rod alone. Nay, it will not be hard to work by two columns of this Table at the same time, and then your Multiplicands and Divisors may be any Number under 100000000. But let us proceed to the third point of the Numbring Rods.

Concerning the Numbring Rods or Bones.

These *Arithmetical Rods* (described by most Authors, who have writ of Arithmetick, since they were first found out) own for their first Inventor, the Right Honourable and Learned *John* Lord *Nepeer*, Baron of *Marchiston*, who put forth a Latin Treatise concerning them, Intituled, *Rabdologia*, that is, a Discourse or Treatise of Rods, calling them *Virgulæ* and *Laminæ*: others have or may call them, *Columellæ*, *Tesseræ*, *Enneades*, adding the *Epithets*, *Numerales* or *Arithmeticæ*. To the same Noble Lord, Posterity is obliged for another

another Rare Invention of *Logarithmes*, both them aiming at, and attaining the ſame end which is, to facilitate and perform with greate diſpatch eaſe and certainty the harder parts of Arithmetick, viz. *Multiplication, Diviſion* and *Extraction of Rootes*. Theſe late years paſt Sir *Samuel Morland* moſt ingeniouſly invented two Arithmetical Inſtruments to the purpoſe above ſaid, for which he deſervs ſingular praiſe. Though the Inſtruments in themſelves be excellent and uſeful, yet they have been hitherto more ſparingly uſed for theſe two reaſons First, becauſe few Artificers are found, who have Hand and Head ſufficient to make them ſo exactly as is requiſite. 2ly, becauſe the Vulgar ſort either wants Heads to comprehend them, or purſes to purchaſe them, being ſomewhat chargeable: whereas the Rods of the Lord *Nepeer* are plain, eaſie and Cheap. He happily fell upon the conceiving and deviſing of them by throughly conſidering the *Pythagorean* Table, in which as before I mentioned, an incredible variety of great and little numbers is found orderly *Tabulated, multiplyed and divided*, with apparent *Multiplyers, Diviſors* and *Quotients*. For example, He ſaid 1234. Tabulated by the firſt 4 capital Columns of the Table, which he multiplyed by 9 and found the *product* in the 9 cell to be (*Collateral additions being obſerved*) 11106. This product he perceived to be alſo a *Dividend* whoſe

whose *Divisor* appeared 1234. and *Quotient* 9. or *vice versa Divisor* 9. and *Quotient* 1234. Further he Noted that 1234. inverted was 4321. This Number he also found Tabulated together by the first four *Transverse Columnes*, which multiplied by 9. gave 38889 in the 9th. *Capital Column*. This being also a *Dividend* shewed 4321 for *Divisor*, and 9. for *Quotient*, or *vicevers*a, &c. But taking a middle Number between 1234. and 4321. For Example, 3142. or 2413. he was at a loss, not finding them Tabulated together, nor the Product lying together, but was to be picked out here and there, not without trouble of the Head and delay of time. This inconvenience happned as he well perceived, because the Table was always made with its Columns fixt in the same gradual Order of Unites, encreasing from 1. to 9. But the Remedy of this inconvenience soon occurred, which was to unfix the fixt columns by cutting them asunder, and making them moveable, apt to be placed in what order he pleased, as occasion required. Thus were the famous *Numbring Rods* extracted and dissected out of the Pythagorean Table, and in reality are nothing else but the Table it self cut out into its Columns, adding thereunto 3 more for the *square*, *cube* and *cypher*-Rods; such as you see in Fig. 2. It is true, the Lord *Nepeer*, to mind the Operator of *collateral Addition*, drew *Diagonal Lines* through all the 8. undercells of every column or

Rod, whereby frequent Rhombes of this shape ◇

appeared in the Rods Tabulated; And whatsoever 2. Figures should be found in one *Rhombe* they were to be added and made one Number. See Fig. 5. Others by making *a cross Diagonal* in the undercells, included the 2. Figures to be added, in this kind of Diamond form ◇ See Fig. 6. Others again included them in a round Circle. See Fig. 7. But because all these three Ways seem to offend the Eye, and breed Confusion by so many Lines; Others with much less ado note all the addend Figures with this mark = or this ≡ declaring that every Figure so Noted requires collateral addition, if Tabulated on the right Hand with another Rod or column on the left. See Fig. 3. yet because the far greater part of the undercells in the Pythagorean Table, (having one Figure more in them then is in the capital) would require this mark = to wit, 58 cells, whereas only 14 cells refuse it: Again, because this mark = and one Figure more then is in the capital require a greater bredth of Rod, I have rather chosen to put an Asterisk *, as a sign of *non addition* to a few cells and lesser Rods, then this Sign of Addition = to four times more cells and larger Rods, declaring that the Star in an undercell hinders *collateral Addition*; and where the Star is not in an undercell, there must ever be *collateral addition*, if another Rod be Tabulated on the left Hand with it.

But here obſerve, that when any (9) hath a ſtar before it, and (1) carried to it, by reaſon of a Rod Tabulated on the right Hand of it, then that (9) becomes 10, and is capable of lateral addition, if another Rod follow on the left Hand. Obſerve alſo, that all theſe Enneads 1. 11. 111. 1111. 11111. and the like *in infinitum*, require Stars in all their undercells, unleſs when a (9) becomes 10 by (1) carried to it, as now we ſaid. Note alſo, that all leſs Numbers then theſe, having equal places or Figures with them in the Vertical, require Stars in all Undercells: For example, 1111. is an Ennead of four places, and ſo is 1000, a leſs Number yet of four places; ſo is 1001. 1002. 1003. and ſo on till we come to 1110. all leſs Numbers then 1111. but all of four places, and requiring Stars in all their undercells. But whatſoever Number of four places is greater then 1111. as is 1112. 1113. 1114. and ſo on till 9999. then infallibly it will reject the Star, and require lateral addition in one or more of the undercells. See the eighth Obſervable.

Moreover, to avoid Multiplicity of Lines, as much as may be, in the Rods, I reduce 8 of thoſe lines to 2. which formerly ſeparated the 9. cells from one another, as you may ſee in Fig. 8. 9. 10. and 11. For dividing the length of the Rod into three equal parts by two lines, I place the three higheſt cells in the firſt Diviſion, three others in the ſecond, and the three laſt cells in the

laſt diviſion. See Fig. 8. 9. 10. and 11. accordi
to this Model of placing Stars before certai
undercells, (*viz.* ſuch as have equal Number o
Figures with their capital cell) and dividin
every Rod or column into three equal parts b
two Lines; I made a Table, wherein all Ca
pital Numbers from 1. to 99 *incluſive*, were mul
tiplied by the 9. *lateral Units*, which Table bein
directly the firſt leſs Extenſion of *Pythagoras* h
Table, I cauſed to be cut in braſs ſome years ago
and a few Copies to be printed for my own an
other Friends uſe. At that time I had in proſpe
the other two leſs Extenſions (2d. and 3d. of *Pyth*
Table) which ſoon were compleated, and tha
very readily, by the help of the double Rod
(whereof I had made ſome Sets) and the Table
of the 1 leſs Extenſion now mentioned: For lay
ing one double Rod at a time to the Columns o
that Table, you Tabulate any number from 100 t
9999. and ſee immediately the *product of multipli
cation* in all the 9 cells. The other Numbers fro
to 99 the Table it ſelf Tabulates and multiplies
See a printed Copy of the Table, inſerted in *pa*
27. As the ſingle Rods of my Lord *Nepeer* wer
cut out of the *Pyth.* Table, ſo both ſingle and dou
ble Rods have been cut out of the Table of the
leſs Extenſion, and found by Experience of 9 or 1
years to double the uſefulneſs of the ſingle Rod
For firſt they ſooner Tabulate any great numbe
with fewer Rods. 2dly they Tabulate the ſe
ſam

me number with great variety of Rods, differing
n *Specie* one from another. See Fig. 12. 3dly they
ake away more then the half of collateral Addi-
ions, the chief trouble of numbring Rods. 4thly
hey more readily shew the product of multipli-
ation and Quotient of Division in great numbers
nd fewer Rods. Two of the double Rods reach

o any number under (*a*) 10000 three of them to

ny under (*b*) 1000000. Four of them to any un-

er (*c*) 100000000. *&c.* This and more the double
Rods perform by themselves. But joyn or Ta-
ulate them with the Table of the 3d Extension,
nd they will most readily multiply and divide
ast numbers. For one Rod and the Table reaches

e (*d*) 1000000. Two to (*e*) 100000000. Three

o (*f*) 10000000000. *&c.* To use them with the
Table of 9999 columns, it is necessary, that the
Rods be of the same length with the columns,

Collat. Additions
(*a*) 1 *at the most*
(*b*) 2 *at the most*
(*c*) 3 *at the most*
(*d*) 1 *at the most*
(*e*) 2 *at the most*
(*f*) 3 *at the most*

though

though the ſame bredth is not preciſely required

The Rods having on them all the Capit Numbers from 1. to 99. they will require eith 50 thin two-faced Talleys, or 25 ſquare-ſide Parallelopipedons of four faces. It will be con venient to have every Rod twice over, (thoug once over will be ſufficient if your ſingle Ro of the 9 Units be twice or thrice over,) where an ordinary Set of ſingle Bones muſt have ever Rod 4. 5. 6. 7. or more times over, according the Operator deſignes the working of greater leſſer Numbers.

Another way of ſupplying the want of mo Rods of one and the ſame Number, may be the Table of 9999. Enneads, for in that Tab are all Numbers of four places, and conſequent this Number 5757. Beſides, in the double Bon are all Numbers of two places, from 10. to 9 *inclusive*, and conſequently this Number 5 wherefore in the Table and double Bones have 57. three times over. But ſetting a the Table, the Bone alone of 57. is in practi equivalent to three or more Bones of the ſa Number 57. for if you ſet down with your R three times 57. thus 575757, as one Verti Number of one Ennead, you will know wh is the Content of every undercell by the und cells of the Rod 57. thrice ſetting them do For example, the ſecond cell of 57. is 1 which thrice repeated, is 114-114-114. Or ſer

rving lateral Addition 1151514, which is the cond cell of the Ennead 575757. In this man-er your Operation will be as ready, as if you d had three distinct Rods of 57 apiece. There yet a third way of most ready *and clear work-g, multiplying and dividing vast Numbers* of the ll same Species of Figures, *viz.* all of Nines, or ights, or Sevens, *&c.* And in what multiplicity ou please, of the same Figures, as 3. 4. 5. Nines, a 10 Nines, 20 Nines, 100 Nines: And so of ights, Sevens, Sixes *&c.* Some 5 special *Enneads*, 5 two-faced Rods (or two four-faced square ods) are required to this sort of Operation, herein you will not be troubled, either with any abulating of Rods, or collateral Addition. See e Scheme of the said *special* Rods *pag. ult.* Fig. 4 where observe that the nine single Units oc-py severally nine Vertical cells, and their under-lls to contain for the most part only 3 Figures, ne leading on the left Hand, another in the mid-le, a 3d. ending on the Right Hand. Some few ndercells (not above 8 in 72) have 4 Figures in hem, and then the two last on the Right Hand are nding Figures. The middle figure is most re-arkable, and more then it appears; For in O-eration it is to be repeated, or taken so often o-er, as there are Figures of one kind in the suppo-d Vertical, abating one: for example, Suppose

* * *

ne *Vertical to be Ten Nines*, or 9999999999. In the

2d. Cell of the special Rod (9) are these thr
figures 198. where (9) in the middle between (1
and (8) is truly nine times nine, that is, one nin
less, then Ten nines in the Vertical: So that th

said 2d. cell 198, is in operation 1999999999
or the Vertical multiplyed by (2) This Rule i
Universal, yet hath two exceptions; first whe
any cell hath four figures in it; 2dly. when an
cell hath a Star prefixt before it, according t
what is abovesaid concerning Asterisks, the
infallibly the middle figure is to abate, not on
ly one, but two of the number in the Vertical
One example will clear all. Let ten fours o

4444444444. be given for a Multiplicand, and
279 for a multiplyer, then in your special Rod o
4 Vertical, take out the ninth cell, apparently
396, but really 39999999996. the middle figur
(9) requiring to be repeated nine times, or one
less, then the number of fours in the Vertical.
Next take out the 7th cell, apparenly 3108 but
really 3111111108. the middle figure (1) re-
quiring Eight repetitions, or two less then Ten
of the Vertical, because this 7th cell hath 4 fi-
gures in it. Lastly take out the 2d cell, appa-
rently * 888. but really * 8888888888. becaus
the middle figure (8) requires 8 repetition
(besides the leading and ending 8) or two les
then Ten of the Vertical, by reason of the Sta

prefi

prefixt before the second cell. The Work ended would appear thus in Multiplication.

Multiplicand	4444444444	39999999996	*cell.9*
Multiplier	——————279	31111111108	*cell.7*
		8888888888	*cell.2*
	Product	123999999876	

In *Division*, *Multiplicand* the *Divisor*, *Product* the *Dividend*, and *Multiplier* the *Quotient*.

Dividend

Divisor 4444444444) 123999999876 (279 *Qu.*
2--8888888888
35111111107
7--31111111108
39999999996
9—39999999996
0000000000

The square and cube Rod ought to be once over in every Set, with three or four cypher-Rods, as you see expresst in Fig. 11, All are to be so orderly placed in a neat pocket case, that every Rod be known what Number it hath, by a mark or figure, even before you take it out of the Case. If you please to reprint the Table of the first less Extension by it self in a page, (with its columns, equal to the Columns of the great Table of 9999.) and give it a Varnish to last the longer, you may immediately thence make Sets of the double bones, meerly by cutting out the capital

columns, and passing them on Talleys of Wood or other matter (two-faced or four-faced) of the same length and bredth with the columns. Besides, as is abovesaid, this little Table of the first less Extension, with one double Rod applied unto it at a time, performs all the whole Work of the great Table of 9999 fixt columns, only with this disadvantage, that it will often have one column lateral Addition, whereas the great Table will have none. Notwithstanding the great performances of the less Table, the great Table hath many special uses, for which it deserves to be published, especially not being of any great extent, nor making any great bulk. By advice of judicious Friends, I thought good to put it forth in a *Duodecimo*, as a convenient *Enchiridion*, or pocket-book, every four pages containing 10 columns with their 500 cells, or every page 2½ columns with 250 cells. In which case the Table alone would require 400 pages in *Duodecimo*. But perhaps it will be better, to contract the pages to half the Number, viz. to 200. in this manner. Let every page have five Ranks of Columns one under another, each Rank consisting of Ten Columns: so will every page contain 50 Columns, and whersoever you open the book, the two pages before your eyes, will shew you a just Hundred of Columns. To find the Number you seek for, more readily, you may Tack to the Margent little outstanding Labells, or Indexes, shew-

g before you open the Book, where every 100 nd 1000 begins, such as are seen in certain ac- ount-books of Merchants. Let the Book be so ound, that whersoever you open it, the leaves n either side, may lye Flat without any uprising; for so it will be more easie to Contabulate the Rods with the Table, when occasion requires. Perhaps it would be better to print it in a little folio, for use at home in your Closet or Library; or then every page would contain its Hundred Columns, easie to be found out by their own natural order.

As well the forementioned Table of 9999 fixt Columns, as the single and double moveable Rods serve equally in Decimal and common Arithmetick; yea in Decimal, they in a manner take away all the trouble of Division. Neither do they require any particular Rules in operation, different from those which have been delivered concerning the Lord *N* single bones, by himself in his *Rabdologia*, by *F. Andrew Taquet*, *Sir Jonas Moor*, Mr *William Leybourne* and others in their Arithmetical Treatises. Wherefore I shall say no more of them, but only shew by single examples, one of multiplication, another of Division, the 3d of extraction of the Square Root, the 4th of the cube Root) the ordinary use of them.

Example of Multiplication.

In *multiplication* commonly it is best to Tabulate the greater Number as *multiplicand* when one

is greater then the other. For example. *Tabulate* 4628 to be *multiplyed* by 72. Place Unit under Unit, as in the Margent (*a*) Then for 2 (the Unit of the *Multiplyer*) take the 2d cell of the *Multiplicand*, *viz.* 9256, and for 7 of the multiplyer take the 7th cell of the *Multiplicand*, *viz.* 32396, and set both cells down, as you see in (*b*) Add the two cells together, and the total Sum or product of multiplication will be 333216 as you find in (*c*) But if you Tabulate 72 to be multiplyed by 4628 the operation will appear as in (*d*).

	4628
(*a*)	72
(*b*)	9256
	32396
(*c*)	333216

	72
	4628
(*d*)	576
	144
	432
	288
	333216

In Division the *Divisor is to be Tabulated*; and it much imports, for the speedier dispatch of your operation, that the *leading Rod* of *the Divisor* be the great Rod or Column of the Table; a quadruple rather then a Triple, a Triple then a double, a double then a single, if the Number of your Divisor will permit,

E

Example of Diviſion

Let 5678556 be a *Dividend*, and 4628 the *Diviſor*. ſet them down as in the Margent (*e*) with a Semilune for the Quotient, and Tabulate the Diviſor. Then enquire how often can the *Diviſor* 4628. be taken out of the firſt *partial Dividend*, viz. 5678. Only once; Therfore put 1 for Quotient in the Semilune, and ſubtract 4628 out of 5678, and there will remain 1050 the work ſtanding (if you caſh the Figures diſpatcht) as in (*f*). Next bring down 5 out of the *Dividend*, and place it on the right Hand of the remainder, as you ſee in (*g*) ſeparated with a Comma. This done, ſeek in the cells of the Diviſor for 10505 (the next partial Dividend) or for the next leſs Number then 10505. In the 2d. cell is 9256 the next leſs. Put 2 in the Quotient, and *Subtract* 9256 out of 10505. and the remainder will be 1249 to which bring down the other 5 of the Dividend, and daſh what is diſpatcht. Then will the work ſtand, as in (*h*)

(*e*) 4628) 5678556 (....

5678558 (1

4628 (*f*)

1050

(*g*) 1050, 5

5678556 (12.

4628

1050, 5 (*h*)

9256

1249.5

In like manner proceed to find the 3d. and 4th figure of the *Quotient*, and the work finished will appear, as in (*i*). Others dash no figures at all, nor place the Quotient on the Right Hand of the *Dividend*, but set every quote-figure over against the cell of the *Divisor* from whence it was taken. Every remainder they distinguish with a colum from the figure brought down out of the *Dividend*, as you may see in (*k*) When in one Number there happen to be two columns, there will be a cypher in the Quotient; when 3 Commaes, then 2 Cyphers in the Quotient. The like Method serves

(*i*) 4628) 5678556 (1227
4628
10505
9256
12499
9256
32396
32396
00000

(*k*) 4628) 5678556
1 - 4628
1050, 5
2 - 9256
1249, 5
3 - 9256
32396
7 - 32396
00000

Extraction of the Square Root, and much *Facilitate* the examining of the work done. If any Number remain after Division ended, it will be the *Numerator* of a Fraction, whose *Denominator* is the *Divisor*. When you turn Integers into a *Radius of Decimals*, *Division* either ceases, or is easily had by cutting off so many Figures (on the Right Hand) from the *product of multiplication* as are in the *Radius*, excepting one.

Example of the Square Roots Extraction

The Extraction of the Square Root is very readily and plain by the Table, or by the double Rods or both of them together. Let the number given, *whose Root you seek*, be 70476025. Put a point under the Unit, and every Altern Figure with a Semilune after the Unit as you see in (*l*) The 4 points foretell that in the operation there will be 4 partial *Dividends*, and as many Roots. Then seek in the cells of the Square Rod for 70 (the 1 partial Dividend) or the nearer less number to 70.64 is the nearest less to 70 in the 8th cell. Therefore 8 *is your first Root* to be placed in the Semilune, and 64 is to be Subtracted out of 70. The remainder will be 6 the work appearing as in (*m*). For the finding the 2d. 3d. or any other Square Roots following, observe these Rules: First, bring down

(*l*) 70476025 (....

(*m*) 70476025 (8...
64
6

the

the next partial Dividend and joyn it to the
remainder on the Right Hand.

Secondly, double the *Root or Roots found*, a
Tabulate that *double* on the left Hand of t
Square Rod or (working by the Table) carry t
Square Rod to the double in the Table.

Thirdly, seek for the Number (or next less)
your last remainder joyned to the next *partial D*
vidend in the cells of the Tabulated Rods and t
Cell wherein it is found, will give you the ne
Root.

Fourthly, Subtract the cells Number out of t
remainder and partial Dividend, and proceed a
before, wherefore in our present example to fin
the 2d. Root.

First, bring down 47 and joyn it to 6 to
make 647.

Secondly, *Double the Root* 8 and *Tabulate* 16 wit
the Square Rod.

Thirdly, seek 647 (or the nearer less) in the
Tabulated Rods the third cell gives 489, the nex
less, which Subtracted out of 647, leaves the re-
mainder 158. The 3d. cell gives 3 for the 2d
Root: see the Margent (n) For the finding o
the 3d. and 4th. Root, proceed as before. Th

(n) 70476025 (83
64
647
489
158

e. who

hole Operation ended ſtands as underneath at
) or according to the Method, mentioned in
ivision, underneath at (p) where any number re-
ains after the work ended, it is the Numerator
f a Fraction, whoſe Denominator is the double
f all the Roots and one Unit more. But if you
eſire a more exact Fraction, add to the Nume-
tor 2. 3. or more Couples of Cyphers, and work
s before, and you will find the nearer Decimal
raction.

(o) 70476025. (839
64
6,47
489
158,60
15021
83925
00000
(p) 70476025
8-64
6,47
3-489
158,60
9-15021
839,25
5--839,25
00000

Example of the Cube-Roote's Extraction.

ſt. ſet down the number (whoſe Cube-root you
ek) with a point under the Unit, and every 3d.

Figure, and a Semi-Lune for the Roots, as unde
neath at (q) how many points, ſo many parti
Dividends and Rootes will be in the Operatio

2ly, Seek in the Cube Rod for 94 or the neare
leſs number: In the 4th cell you find the neareſt
Set down 4 for the 1 Root and Subtract 64 o
of 94, the remainder will be 30; and the work ap
pear as in (r)

For the finding of the 2d, or any other follow
ing Root, obſerve theſe Rules.

1ſt. Bring down the next partial Dividend 8
and joyn it to the remainder 30, on the Righ
Hand, as in (s)

2ly, Tabulate the triple of Root or Roots found
(*Root* 4 *the triple* 12) with Rod or Rods a part ca
them for diſtinction, *Right Hand Rods.*

3ly. Tabulate the triple of the Sq. of the Root
found (Root 4 Square 16 the triple of 48) wit
Rod or Rods. placed on the left Hand, of the
Cube Rod: call theſe left Hand Rods. Or work
ing by the Table, carry your cube-Rod to 48 i
your Table.

4ly, Seek for 308 18 the preſent partial dividen
or next leſs number, in the cells of the left Han
Rods. In the 6th cell you find 290 16 the next le
yet indeed too much, as will after appear. Set th

(q) 938188 16 (4..

(r) 948188 16 (4..

64

30

(s) 30, 818

his number down apart, and draw a line above it, as you see in (t) over the Unit; and above the ine place 6 the number of the cell, out of which 90016 was taken: On the left Hand of 6 place he Square of 6, *viz.* 36 as you see in (u) then take he 6th and 3d. cell (by reason of 36 the Square) out of the right Hand Rods, *viz.* 72 and 36 and place them as you see in (w) adding all the numbers under the line into one Sum, *viz.* 33336, as you see in (x) which being too great to be taken out of 30818. you must go back and take a less cell, then 6.

(t) 39. 6
29016
(u) 366
29016
(w) 72
36
(x) 33336
(y) 255
24125

Take therefore the cell 5. which hath in it the he number 24125. write it apart with a line above it, and an above line over the Unit: place 5 the cells number) and on the left Hand of 5 the he Square of 5 *viz.* 25 as in the margent (y) ake out of the right Hand Rods the 5th. and 2d. ell (by reason of the Square 25) *viz.* 60 and 24 and add them, as you see in (z) to make 27125 which taken out of 30818 there will remain 3693 and the work stand as in the margent

(z) --25, 5
24125
60
24
27125

(a) 94818816 (45
64
30,818
27125
3693

gent. (a) For the 3d Roo
do as you did for the 2d.

1st, Bring down the ne
Dividend and joyn it to th
last remainder.

2ly, Tabulate a part on the right Hand Rod
the triple of the Roots found.

3ly, Tabulate the triple of the Square of th
Roots on the left Hand of the Cube-Rod.

4ly, Seek in the cells of the left Hand rods fo
the left Hand rods for the partial Dividend.

5ly, Set down apart the number required *foun*
and draw a line above it: above that line an
over the Unit place the Figure of the cell take
and on the lefthand of the figure, place its squar
as was expressed as before above in the margen
(u) the whole Operation ended, will appear bri
ly as in (b)

(b) 94818816. (456
64
30,818
27125
3693816
3693816
0000000

Note first, that scarce can you give any prec
in writing concerning Extraction of rootes,
clear, but that they shall confound or puzzle
youug Student of Arithmetick, who will be ab
to learn more in an Hour of a Master shew

him the practice, than in a day or week by his own reading of precepts.

2ly, note, that in Cubick Extractions it is not easie to foresee or prevent the taking of too great a number out of the *left Hand and Cube-Rods*. We may probably conjecture that it will happen so, when the number taken is almost as great as the partial Dividend, and yet is to be increased by adding 1 or 2 cells more out of the *Right Hand Rods*.

3ly, Note, that when the capital cell of the left hand and cube-rods is greater than the partial Dividend, a *Cypher* is to be put in the *Quotient* as a *Root*, and the next partial dividend is to be brought down and joyned to the former.

4ly, note, that if any number remain after Extraction, it must be set down as the Numerator of a common Fraction, whose Denominator is a number made of the *triple of all the* rootes, and of the triple of the Square of all the rootes, and an Unity. For example. The rootes being 456 the *Denominator* would be 625177. See the Margent (c) But far better it is to add to to the Numerator, or the remaining number, 3 or 4 triples of cyphers thus, 000, 000, 000. and work out by the precedent rules a clear and plain decimal Fraction.

Triple of Rootes.	1368
Triple of Square.	623808
Unity ———————	1
Summa	625177

Thus much (and indeed more than I first intended) concerning *Pythagoras* his Table, the Extensions thereof, and the Numbring Rods.

And

And here I might (had I not been too long already) exemplify in a few instances; and thereby shew, that whatsoever is performed by *Logarithmes* in Problemes of Trigonometry, *Sines, Tangents, Secants, Questions of Interest*, &c. may be also performed by this Table of the *thirdless Extension*, and the *double Rods*, or by the double Rods alone: whether with more readiness and clearness, Practice and Experience must shew.

What also can be performed by Mr. *Briggs's* Table of 20 Chiliades of Logarithmes, may be done (if I mistake not) more plainly and speedily by this Table. For though it be but the half of 20 Chiliades, (it being only 10 Chiliades), yet by applying one double Rod thereunto, it exceeds 20 Chiliades by 980000 Chiliades.

For Conclusion, I will here suggest certain Lines divided into certain digits, which are singularly useful in measuring most things measureable, and make your Operation quick and plain, without trouble of division, or necessity of reducing inches into other known Integers. For though you measure by digits only, and multiply them by one another, yet the Product of Multiplication immediately gives you in hundreds or thousands, the superficial or solid content, not only in digits, but in other known termes of Feet, Yards, Acres, Gallons, Barrels, Bushels, &c. For Wine-Gallon-digits proceed thus; Take the *Cube Root* of 231, (the solid inches in

a Wine-Gallon) which is 6,136 *vulg. Inc. proxime*. *Divide* this Root into ten equal parts exactly, with ſubdiviſions of each part into other ten leſs parts, and you have the Wine-Gallon-digits.

You meaſure by them, for example, a cylindrical capacity, and find the Diameter of it to be 56 digits, and height 60 digits, *the area* of that circle will be 24,64 ſuperficial digits, which multiplied by 60 digits, produces 147. 840 ſolid digits, whereof every thouſand is a juſt Wine-Gallon. There are therefore 147 Gallons, and 840 digits towards another thouſand or Gallon; that is above three quarts.

For Beer or Ale Gallon digits, take the cube Root of 282 ſolid vulg. inches in the Ale Gallons, which is 6,558 *proxime*. *Divide* this Root into ten equal parts, with ſubdiviſions, as above.

For *Beer-barrel-digits*, take the cube Root of 10152 (ſolid vulg. inc. in a Beer-barrel of 36 Gall.) which is 21,653 *proxime*, to be divided into ten equal parts with ſubdiviſions, as before.

For Foot-digits take the ſquare-Root of 144 (a Foot ſquare) or cube-Root of 1728, (a Foot ſolid) both which is 12 common inc. Divide this Root 12 into ten equal parts, with ſubdiviſions; meaſure and work by them, every hundred ſquare will be a true Foot ſquare, equal to 144 common inc. and every thouſand ſolid, a Foot ſolid equal to 1728 com. inc. For example, you meaſure a tetragon pyramide, whoſe one ſquare ſide is 50 Foot-digits, and height 60. The ſquare

of

of 50 is 2500, and gives the area of the pyramid at the bottom, *viz.* 2500 sq. dig. or 25 sq. Feet; multiply the area 2500 by 20 (a 3d of the height 60) and the product will be 50000 sol. dig. that is 50 solid Feet, equal to 86400 solid common inc.

These 4 lines of Wine-gall. dig. Beer-gall. dig. and foot-digits, are of excellent use in Gauging, and measuring any thing by feet sq. or solid; and may be conveniently cut on a Ruler, or long measuring staff, hard by or on both sides of a line of common inches, so that by meer inspection you may see how much they differ amongst themselves, and from common inches. If you desire yard-dig. to measure by sq. or cube-yards, divide 36 the square Root of 1296 (a sq. yard in common inches) and cube Root of 46656 (a yard sol. in common inches) into ten equal parts, as in other digits above; So may you have bushel-dig. by dividing 12,958, which is *proxime* the cube Root of 2176 (commonly esteemed a solid bushel in vulgar inches) into 10 equal parts. For measuring of Land, Mr. *Gunter*'s Chain (of 100 links, equal to 4 perches or 66 foot in length, is very convenient. Every 10000 sq. links is a chain sq. or 16 perch. sq. or the 10th. part of an Acre s. 100000 of links sq. is 10 chains sq. or 160 perches sq. or an Acre sq.

Note 1. That when the Root is great, as 20, 30, or more vulg. inc. then you may divide it into more than 10 equal parts, as 100. 1000, &c.

Note 2. That in working by the aforesaid Root-dig, the contingent Fractions will be decimal and clear.

FINIS.

ERRATA.

Fol. 32. lin. 12. set them thus 72.

a 4628
72
b 9259
32396
c 333216

Fol. 33 l. 21. read thus e 4628) 5678886 (1227
f 4628
g 1050, 5
9256
b 1249, 5
9256
3239, 6
32396
00?00

Fol. 39 l. 12.

v. 30, 6
29016
w 72
36
x 33336

TETRASTICHON.

In Enneadas Arithmeticas.

COnditor Æneidos peperit ſibi nobile Nomen;
Nullum Nomen habet Conditor Enneados.
Si tamen Enneados, quæratur, quis fuit Author?
Baro, Refer, Neperus, Pythagorasque fuit.

The Æneid's Author is a Man much Fam'd,
The Ennead's Author not ſo much as Nam'd;
But if you are askt who th' Ennead's Author was,
Say Lord *John Neper*, and *Pythagoras*.

DISTICHON.

In Tabulam 10000 Enneadum.

HAc Tabula Enneadas decies tibi Mille Miniſtrat
Pythagoræ tantum priſca Tabella decem.

This Table gives Ten Thouſand Enneades, when *Pythagoras*'s Old Table gives but Ten.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
*2	*4	*6	*8	10	12	14	16	18	20	22	24	26	28	*30	*
*3	*6	*9	12	15	18	21	24	27	*30	*33	*36	*39	*42	*45	*
*4	*8	12	16	20	24	28	32	36	*40	*44	*48	*52	*56	*60	*
*5	10	15	20	25	30	35	40	45	*50	*55	*60	*65	*70	*75	*
*6	12	18	24	30	36	42	48	54	*60	*66	*72	*78	*84	*90	*
*7	14	21	28	35	42	49	56	63	*70	*77	*84	*91	*98	105	1
*8	16	24	32	40	48	56	64	72	*80	*88	*96	104	112	120	1
*9	18	27	36	45	54	63	72	81	*90	*99	108	117	126	135	1

34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
*68	*70	*72	*74	*76	*78	*80	*82	*84	*86	*88	*90	*92	*94	*96	*
102	105	108	111	114	117	120	123	126	129	132	135	138	141	144	1
136	140	144	148	152	156	160	164	168	172	176	180	184	188	192	1
170	175	180	185	190	195	200	205	210	215	220	225	230	235	240	2
204	210	216	222	228	234	240	246	252	258	264	270	276	282	288	2
238	245	252	259	266	273	280	287	294	301	308	315	322	329	336	3
272	280	288	296	304	312	320	328	336	344	352	360	368	376	384	3
306	315	324	333	342	351	360	369	378	387	396	405	414	423	432	4

67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	8
134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	1
201	204	207	210	213	216	219	222	225	228	231	234	237	240	243	2
268	272	276	280	284	288	292	296	300	304	308	312	316	320	324	3
335	340	345	350	355	360	365	370	375	380	385	390	395	400	405	4
402	408	414	420	426	432	438	444	450	456	462	468	474	480	486	4
469	476	483	490	497	504	511	518	525	532	539	546	553	560	567	5
536	544	552	560	568	576	584	592	600	608	616	624	632	640	648	6
603	612	621	630	639	648	657	666	675	684	693	702	711	720	729	7

5	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
0	*32	*34	*36	*38	*40	*42	*44	*46	*48	*50	52	*54	*56	*58	*60	*62	*64	*66
5	*48	*51	*54	*57	*60	*63	*66	*69	*72	*75	*78	*81	*84	*87	*90	*93	*96	*99
0	*64	*68	*72	*76	*80	*84	*88	*92	*96	100	104	108	112	116	120	124	128	132
5	*80	*85	*90	*95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
0	*96	102	108	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198
5	112	119	126	133	140	147	154	161	168	175	182	189	196	203	210	217	224	231
0	128	136	144	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264
5	144	153	162	171	180	189	198	207	216	225	234	243	252	261	270	279	288	297

8	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
6	*98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132
4	147	150	153	156	159	162	165	168	171	174	177	180	183	186	189	192	195	198
8	196	200	204	208	212	216	220	224	228	232	236	240	244	248	252	256	260	264
0	245	250	255	260	265	270	275	280	285	290	295	300	305	310	315	320	325	330
8	294	300	306	312	318	324	330	336	342	348	354	360	366	372	378	384	390	396
6	343	350	357	364	371	378	385	392	399	406	413	420	427	434	441	448	455	462
4	392	400	408	416	424	432	440	448	456	464	472	480	488	496	504	512	520	528
2	441	450	459	468	477	486	495	504	513	522	531	540	549	558	567	576	585	594

8	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
6	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
4	246	249	252	255	258	261	264	267	270	273	276	279	282	285	288	291	294	297
8	328	332	336	340	344	348	352	356	360	364	368	372	376	380	384	388	392	396
0	410	415	420	425	430	435	440	445	450	455	460	465	470	475	480	485	490	495
8	492	498	504	510	516	522	528	534	540	546	552	558	564	570	576	582	588	594
6	574	581	588	595	602	609	616	623	630	637	644	651	658	665	672	679	686	693
4	656	664	672	680	688	696	704	712	720	728	736	744	752	760	768	776	784	792
2	738	747	756	765	774	783	792	801	810	819	828	837	846	855	864	873	882	891

Figure. 1

A									B
0	1	2	3	4	5	6	7	8	9
0	2	4	6	8	10	12	14	16	18
0	3	6	9	12	15	18	21	24	27
0	4	8	12	16	20	24	28	32	36
0	5	10	15	20	25	30	35	40	45
0	6	12	18	24	30	36	42	48	54
0	7	14	21	28	35	42	49	56	63
0	8	16	24	32	40	48	56	64	72
0	9	18	27	36	45	54	63	72	81

Fig. 2

S.	Cu.	
4	08	0
9	27	0
16	64	0
25	125	0
36	216	0
49	343	0
64	512	0
81	729	0

Fig. 5

1.	2.	3.	4.
2	4	6	8
3	6	9	12
4	8	12	16
5	10	15	20
6	12	18	24
7	14	21	28
8	16	24	32
9	18	27	36

Fig. 6

1.	2.
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18

Fig. 7

3.	4.
6	8
9	12
12	16
15	20
18	24
21	28
24	32
27	36

Fig. 8

12	34
*24	*68
*36	102
*48	136
*60	170
*72	204
*84	238
*96	272
108	306

Fig. 13

	1	2	3	4	5	6	7	8	9
*	2	4	6	9	1	3	5	7	8
*	3	7	0	3	7	0	3	0	7
*	4	9	3	8	2	7	1	5	6
*	6	1	7	2	8	3	9	4	5
*	7	4	0	7	4	0	7	3	4
*	8	6	4	1	9	7	5	2	3
*	9	8	7	0	5	4	3	1	2
	1	1	1	1	1	1	1	0	1.

Fig. 14

1	2	3	4	5	6	7	8
*111	*444	*666	888	110	132	154	176
*333	*666	999	132	165	198	231	264
*444	*888	132	170	220	204	3108	352
*555	110	165	220	275	330	385	440
*008	132	108	204	330	396	402	532
*777	154	231	3108	385	462	5439	621
*888	176	264	352	440	5328	0210	710
*999	198	297	396	495	594	693	792

A

Fig. 3

B

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

Fig. 4

S.1	Co1	o
4	08	o
9	27	o
16	64	o
25	125	o
36	216	o
49	343	o
64	512	o
81	729	o

Fig. 9

1 2 3
*246
*369
*492
*615
*738
*861
*984
1107

Fig. 10

1 2 3 4
*2468
*3702
*4936
*6170
*7404
*8638
*0872
11106

Fig. 11

S. 1	Co1	o	oo	ooo
*4	*08	*o	*oo	*ooo
*9	*27	*o	*oo	*ooo
16	*64	*o	*oo	*ooo
25	125	*o	*oo	*ooo
36	216	*o	*oo	*ooo
49	343	*o	*oo	*ooo
64	512	*o	*oo	*ooo
81	729	*o	*oo	*ooo

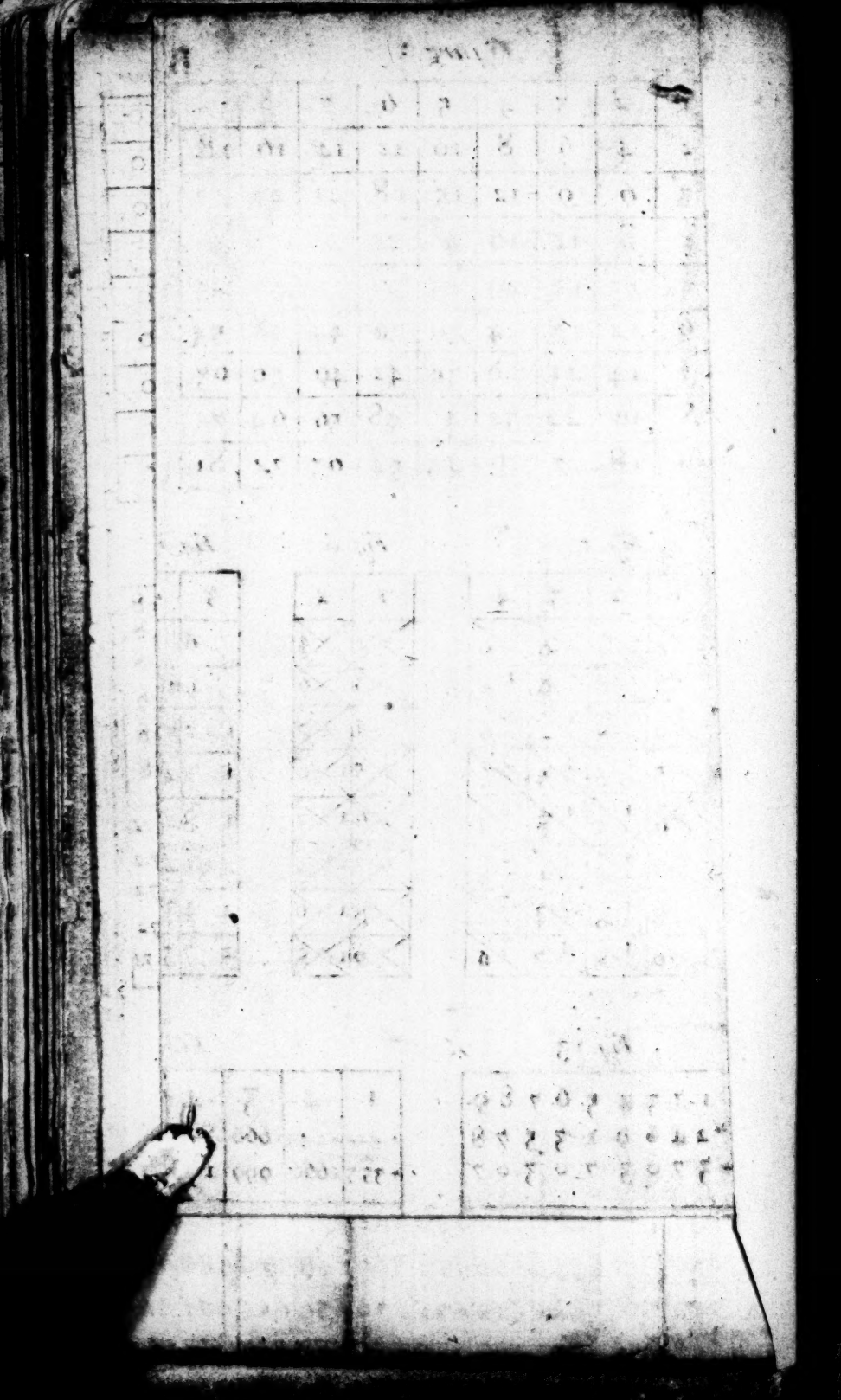
Fig. 12

78,96,78
78,96,7,8
78,9,67,8
7,8,9,67,8
7,8,96,78
7,8,9,6,78
54,72,54,72
54,72,5,47,2
54,7,25,4,72
5,47,25,4,72
5,4,7,2,54,72

Fig. 15

Sq1	C o1	o	*oo
*4	*08	*o	*oo
*9	*27	*o	*oo
16	*64	*o	*oo
25	125	*o	*oo
36	216	*o	*oo
49	343	*o	*oo
64	512	*o	*oo
81	729	*o	*oo

8	9
176	198
264	297
352	300
440	495
5328	504
6216	693
7104	792
792	891



9. [illegible] . 36. 49. 64. [illegible]

.27. 64. 125. 216. 343. 512. 729. [illegible]

.81. 156. 625. 1296. 2401. 4096. 6561. 100[illegible]